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REMARKS

Claims 1-22 have been presented in this application. These claims relate to an electroplating solution for the deposition of silver; the solution containing silver in the form of a complex of silver with hydantoin or a substituted hydantoin compound; the solution also containing an excess of the hydantoin or substituted hydantoin compound employed, together with an effective quantity of a nonprecipitating electrolyte salt, and also an effective quantity of 2,2' dipyridyl for the purpose of obtaining a mirror-bright to brilliant deposit. More particularly, these claims are directed to a non-cyanide silver electroplating solution comprising:

- (a) a premade aqueous solution of silver in the form of a complex of silver with hydantoin or a substituted hydantoin compound wherein said solution includes an excess molar ratio of the hydantoin or substituted hydantoin compound;
- (b) a premade aqueous solution of a conducting electrolyte comprising an effective quantity of a nonprecipitating electrolyte salt, and the hydantoin or a substituted hydantoin compound employed in part (a); and
- (c) an effective quantity of 2,2' dipyridyl for the purpose of obtaining a mirror-bright to brilliant deposit.

Amendments:

Claim 17 has been cancelled without prejudice. Claims 1, 4, 5, 6, 12, 15, and 16, have been amended to better define the invention. Support for the amendments is found throughout the specification as filed, and no new matter has been added.

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The Abstract has been amended as requested by the Examiner.

The specification has been amended to provide the generic chemical descriptions of the trademarked surface-active materials previously identified only by the trademark. Again, no new matter has been added.

Claim Rejections - 35 U.S.C. §112

Claims 4-6, 8-11, 15, 17, 20 and 22 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. In view of the amendments made to the claims this rejection may be withdrawn. Such action is respectfully requested.

Claim Rejections - 35 U.S.C. §103

1. Claims 1-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP 11-302893 ('893). This rejection is respectfully traversed for the following reasons:

The present application describes an electroplating solution and process in which the silver is contained as a complex of silver with a hydantoin (preferably, 5,5-dimethyl-hydantoin) in a molar ratio of 1:2. As taught in the specification, the first part of the solution is a premanufactured concentrate of this material by reacting silver oxide with the hydantoin at alkaline pH, so that there are no extraneous anions. Next reacted are potassium hydroxide with sulfamic acid in a separate aliquot of water to form a conducting electrolyte at the requisite pH, and to this is added an additional quantity of the hydantoin. Both the sulfamate and the additional hydantoin act to corrode and solubilize the anodes during the actual plating process. Finally, the silver concentrate is

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combined with the electrolyte to form the actual plating solution, and to this is added sufficient quantities of 2,2'-dipyridyl (the preferred Brightener), Rhodacal N (the preferred Additive) and water to adjust to final volume.

In JP '893 (as well as Asakawa and Soutar), silver is added to the plating solution as a salt of silver with an inorganic or organic acid, usually the nitrate, and thus, the platable silver species is formed *in situ*. This is in contrast to the solutions of the present application, wherein the silver complex is premanufactured separately and introduced in a prefinished form. The claimed solution avoids the introduction of extraneous anions which are typically not be desirable in an electroplating bath. Nitrate in particular has been associated with tarnishing after plating in succinimide-based solutions.

The present application and Asakawa's patent correctly refer to hydantoins as complexing agents for silver. JP '893 refers to them as chelators [0041], and Soutar (Col. 5, lines 33 ff and Col. 6, lines 1-27) claims multidentate ligands as complexing agents for silver. A chelate is a ring compound formed by reaction of a metal to form at least partially ionic bonds with more than one functional group of a single polydentate molecule. Silver exhibits only a valence of +1. It cannot form chelates, either with hydantoins or with polydentate complexing agents of the type indicated by Soutar. Moreover, JP '893 states explicitly [0041] that the hydantoin(s) are present only as an auxiliary component.

Nothing in JP '893 makes the presenly claimed invention obvious. The JP patent does teach a cyanide-free electroplating bath for silver, and a process for the use of that bath. The JP patent also teaches the use of pyridine compounds and hydantoin compounds. However this is where the similarities end. One primary difference is that JP '893 specifically requires the use of "fusibility compounds" namely salts of metals

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chosen from As, Bi, Cd, In, Ni, Pb, Se, Sb, Te and Tl, among others. See Paragraph [0033] of the Computer Translation.

The bath composition taught in JP '893 is overly complex compared to the simple composition taught and claimed herein. The present invention reports a simple electroplating composition for the deposit of silver in a mirror-bright to brilliant form, without all of the components required by JP '893. Given that there is no teaching in JP '893 that would lead the skilled artisan to select the specific bath composition claimed herein, the obviousness rejection should be reconsidered and withdrawn. Such action is respectfully requested.

2. Claims 7-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP 11-302893 ('893) as applied to claims 1-6 above, and further in view of Soutar et al. (US Patent No. 5,955,141). This rejection is respectfully traversed for the following reasons:

The teachings of JP '893 have been distinguished above. The Examiner's reliance upon the teachings of Soutar (US 5,955,141) is misplaced. Soutar does not teach a current-based electroplating bath as claimed herein, or as taught and claimed in JP '893. Instead, Soutar teaches a form of current-free plating (distinct from electroless plating), characterized as follows (see Col. 4, lines 61-67):

The present invention relates to a displacement immersion silver-plating process. A displacement plating process differs from an electroless process because the silver coating forms on the surface of a metal by a simple displacement reaction due to the relative electrode potentials of the oxidizable metal of the surface to be protect and of the silver ions respectively.

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Thus, the bath ingredients employed by Soutar must be useful in a process that does not employ current in order to deposit the silver. Contrast this with both the present invention and the teachings of JP '893, where if there is no current – there is no deposit of silver. These arts are simply incompatible. Some of the teachings of Soutar might be “obvious to try” in a current-based electroplating bath, but that is not the proper standard on which an obviousness rejection can be maintained.

The solution described by Soutar comprises a soluble source of silver ions together with one or more multidentate complexing agents. As mentioned previously, the multidentate complexing agent is described in the body of the patent as being a complexing agent for silver itself. In the Claims, however, mention is only made of an aqueous composition comprising silver ions and a complexing agent that is a multidentate ligand. In view of the application intended, it seems that a significant function of the multidentate ligand(s) is actually to promote corrosion and sequestration of ions from the substrate, thus allowing the current-free displacement deposition process to proceed.

In addition, Soutar, unlike JP '893, recognizes the deleterious nature of chloride ion in solutions containing silver (see Col. 6, lines 37-42) and devotes Claim 24 to specifying a halide-free solution. Practical silver plating solutions are replenished almost entirely from the anodes. On a cost basis this is far cheaper than replenishing by addition of soluble silver salts of just about any kind. Precipitant species such as chloride or bromide, sulfate, phosphate, etc., even if present in the plating solution at concentrations not high enough to cause precipitation in the bulk of the solution, can cause stains and interfere with the operation of the anodes; and this is probably the most important reason to avoid them.

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Also in support of this rejection the Examiner has questioned the use of the terms "non-precipitating electrolyte salt." The present inventor has the following comments on that point:

When I wrote the application I went to some pains to specify that the electrolyte be nonprecipitating, i.e., not capable of forming a precipitate with silver. I did this because Asakawa included potassium chloride or sodium chloride in his Examples, and despite the opinion of the Examiner, chloride ion is anything but a nonprecipitating electrolyte for silver. In the absence of a suitable complexing agent, chloride will invariably precipitate silver from just about any solution. This being so, why deliberately add it?

The proposed combination of JP '893 and Soutar is improper and it fails to support the obviousness rejection, which should be reconsidered and withdrawn. Such action is respectfully requested. Moreover, even if these teachings are properly combinable as suggested by the Examiner, the teachings are themselves incompatible, as discussed above.

3. Claims 12-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP 11-302893 ('893). This rejection is respectfully traversed for the following reasons:

JP '893 has been distinguished above. The presently claimed bath is unobviously different and the use of the present bath for making mirror-bright to brilliant silver electrodeposits is likewise unobviously different from the teachings of JP '893. Reconsideration and withdrawal of this rejection are respectfully requested.

4. Claims 18-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP 11-302893 ('893) as applied to claims 12-17 above, and further in view of Soutar et al.

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(US Patent No. 5,955,141). This rejection is respectfully traversed for the following reasons:

Both JP '893 and Soutar have been distinguished above. The proposed combination is improper as the arts are not sufficiently related to support the combination of the teachings. Reconsideration and withdrawal of this rejection are respectfully requested. Moreover, even if these teachings are properly combinable as suggested by the Examiner, the teachings are themselves incompatible, as discussed above.

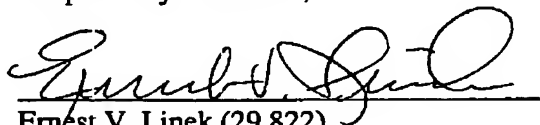
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CERTIFICATE OF FACSIMILE TRANSMISSION

The undersigned hereby certifies that this correspondence was submitted by facsimile in the USPTO on the date shown on Page 1.

Respectfully submitted,


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